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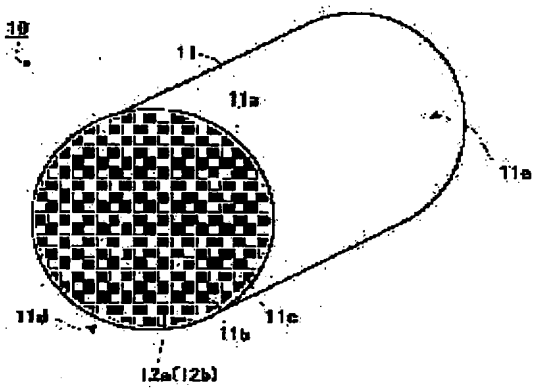
(54) POROUS CERAMIC HONEYCOMB FILTER

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a porous ceramic honeycomb filter which has a porous ceramic honeycomb structure, has an outer peripheral wall and many cells surrounded by cell walls on the inner peripheral side of the outer peripheral walls and the one end face of which is sealed by using a sealant, for collecting fine particles contained in exhaust gas by the cell walls by making the exhaust gas pass through the pores of the cell walls and flow through the adjacent cells and whose fine particle collecting efficiency is high and whose pressure loss is low even when the porosity of the cell wall is ≥55% and a catalyst is deposited on the porous ceramic honeycomb filter.
SOLUTION: The porosity of the cell wall is 55-75%, the average pore size is 10-40 μm and the surface roughness (the maximum height Ry) is ≥10 μm.



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CLAIMS

[Claim(s)]
[Claim 1]A peripheral wall.
A cell of a large number surrounded with a cell wall by the inner circumference side of this peripheral wall.
It is the porosity ceramic honeycomb filter provided with the above, and porosity of said cell wall is characterized by an average pore size's being 10-40 micrometers, and surface roughness (maximum height Ry) being not less than 10 micrometers 55 to 75%.

[Claim 2]The porosity ceramic honeycomb filter according to claim 1, wherein porosity of said cell wall is 60 to 70%.
[Claim 3]The porosity ceramic honeycomb filter according to claim 1 or 2, wherein a main crystal of ceramics which constitute said cell wall is cordierite.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the porosity ceramic honeycomb filter which catches the particles contained in exhaust gas, such as a diesel power plant.
[0002]
[Description of the Prior Art]Reduction of the toxic substances contained in the exhaust gas discharged from engines, such as a car, from the preservation side of local environment or earth environment is called for. In order to catch the particles especially contained in exhaust gas, such as a diesel power plant, a porosity ceramic honeycomb filter (henceforth [a "porosity ceramic honeycomb filter" is omitted and] a "honeycomb filter") attracts attention, and has come to be used.
[0003]Drawing 1 is a perspective view of the honeycomb filter 10, and drawing 2 is a type section figure of the honeycomb filter 10 of drawing 1. As shown in drawing 1 and drawing 2, usually the honeycomb filter 10, The porosity ceramic honeycomb structured body which has the cell 11c of a large number approximately cylindrical and surrounded with the cell wall 11b by the inner circumference side of the peripheral wall 11a and this peripheral wall 11a. (Hereafter, a "porosity ceramic honeycomb structured body" is omitted and it is called a "honeycomb structured body") The inflow side of the cell 11c of 11 is ******(ing) the both-ends side by the side of [11e] 11 d and an outflow by the ****** material 12a and 12b by turns. And the honeycomb filter 10 is stored by the metal vessel by the planar pressure of gripping members, such as a ceramic fiber mat inserted as a compression state within the metal vessel (not shown).

[0004]Exhaust gas purification with the honeycomb filter 10 is performed as follows. By drawing 2, exhaust gas flows from the cell 11c as for which the inflow side of the honeycomb filter 10 is carrying out the opening at 11 d (10a shows), flows into an adjacent cell from the fine pores (not shown) formed in the cell wall 11b, and is discharged from the outflow side 11e (10b shows). And when particles contained in exhaust gas pass to an adjacent cell from the fine pores which continue within the cell wall 11b, they are filtered, and they are caught. And if a fixed quantity of caught particles become above, combustion removing will be carried out by electric heater, a burner, etc., and reproduction of the honeycomb filter 10 will be performed.
[0005]There is also a method of lowering the combustion temperature of particles and burning the caught particles continuously by supporting catalysts, such as a platinum metal metal catalyst, to the fine pores (not shown) formed in the cell wall 11b and the cell wall 11b of the honeycomb filter 10. Now, it is required for the honeycomb filter 10 that the collection efficiency of particles is high and that pressure loss should be low. If the collection efficiency of particles is high and pressure loss is low, the increase in back pressure in the engine accompanying accumulation of particles will become slow, the time which can continue catching will become long, and the interval to reproduction will also become long. However, generally, collection efficiency and pressure loss have a relation of reverse proportion, if it is going to make collection efficiency high, pressure loss will increase, and on the other hand, if it is going to make pressure loss low, collection efficiency will come to get worse. The porosity and average pore size of the

cell wall of the honeycomb filter were adjusted so that collection efficiency and pressure loss could be compatible conventionally, but there was a limit. When burning particles continuously with the catalyst supported especially, as a carrier high specific surface area materials, such as activated alumina, from it being necessary to coat the inside of the fine pores of a cell wall. It was difficult for high specific surface area material to blockade the fine pores of a cell wall, and for pressure loss to become high compared with the filter which is not coated, and to obtain the filter of a low-pressure power loss with high collection efficiency.

[0006]In order to solve the above-mentioned problem, to JP,7-163823,A. In addition to considering it as 60% or less not less than 45%, the porosity of a cell wall toward an inside from the surface The specific surface area M of an opening and all the fine pores to penetrate (m^2/g). By making a relation with surface roughness N (micrometer) in the filter surface into the range of 1000M+85N >=530. The number of the fine pores which were chained with the inside and penetrated is made to increase from a filtering area and a filter surface, catching time is long and the honeycomb filter in which it could be made to lessen reproduction frequency is indicated.

[0007]For porosity to be carried out not less than 40%, and for an average pore size be not less than 5 micrometers 50 micrometers or less 55% or less at JP,8-931,A the value as for which Valley Level becomes by in addition, the thing to consider as 20% or less. The detachability of the particles caught on the honeycomb filter surface becomes good, and the honeycomb filter which was going to improve regeneration efficiency by back wash exhaust air is indicated. With Valley Level, three-dimensional analysis of the data of the granularity of a filter surface is conducted with a tracer type surface roughness meter here, The field that the volume of the heights of a filter and the volume of a crevice became equal to a certain field was made into the average side, and when it assumes that the filter was cut in respect of this average, it is defined as the ratio to the total surface area of the sum of the fine-pores area in an average side.

[0008]

[Problem(s) to be Solved by the Invention]However, the honeycomb filter of the indication to said JP,7-163823,A, The effect which enlarges the collection surface product of a cell wall by 2.3-7.4 micrometers and a comparative example since it is about 3.1-7.4 micrometers in the example as given [surface roughness] in Table 2 of the gazette was not acquired, but there was a problem that the collection efficiency of particles was also low, substantially. For this reason, pressure loss was low and it was difficult to obtain a filter with high collection efficiency of particles moreover.

[0009]Porosity is not less than 40% of 55% or less, and the honeycomb filter of the indication to said JP,8-931,A had the problem of being easy to increase pressure loss. Although the detachability of the particles caught on the surface by making into 20% or less the value which becomes Valley Level became good, there was also a problem that there were few effects of catching the particles in exhaust gas with a cell wall. In JP,8-931,A, a concrete statement is not found about the value of surface roughness.

[0010]In light of the above-mentioned problems, this invention enlarges the porosity of a cell wall, and suppresses pressure loss low, and there is in obtaining a honeycomb filter with high collection efficiency of the particles in exhaust gas.

[0011]

[Means for Solving the Problem]This invention persons were specifying porosity in a honeycomb filter, and an average pore size, and making surface roughness (maximum height Ry) of a cell wall large beyond a predetermined value, acquired knowledge that an aforementioned problem is solvable, and thought out to this invention.

[0012]Namely, a honeycomb filter of this invention ****** an end face of a cell of a honeycomb structured body which has a cell of a large number surrounded with a cell wall by the inner circumference side of a peripheral wall and this peripheral wall, It is a honeycomb filter which catches particles which pass fine pores of said cell wall, pass exhaust gas to an adjacent cell, and are contained in exhaust gas with said cell wall, Porosity of said cell wall is characterized by an average pore size's being 10-40 micrometers, and surface roughness (maximum height Ry) being not less than 10 micrometers 55 to 75%.

[0013]It is because collection efficiency of particles will fall, and intensity will also fall, if pressure loss becomes it large that porosity is less than 55% and porosity exceeds 75%, so it is not suitable here as a filter for particle catching to have made porosity of a cell wall into 55 to 75%. The more desirable range of porosity is 60 to 70%.
[0014]That an average pore size of a cell wall was 10-40 micrometers, It is because detailed particles will penetrate a cell wall, and collection efficiency will fall, and intensity will also fall, if pressure loss becomes it large that an average pore size is less than 10 micrometers and an average pore size exceeds 40 micrometers, so it is not suitable as a filter for particle catching. Porosity and an average pore size are measured using a mercury pressure ON type porosimeter.
[0015]That surface roughness (maximum height Ry) of a cell wall was not less than 10 micrometers, In spite of having set up so that 55 to 75% may be stopped in porosity and 10-40 micrometers and pressure loss may be low suppressed in an average pore size, it is because it becomes possible to catch particles efficiently by an uneven part formed in the cell wall surface. There are few effects that surface roughness (maximum height Ry) of a cell wall catches particles in exhaust gas with a cell wall in less than 10 micrometers, and they are not suitable as a filter for particle catching. The more desirable range of surface roughness (maximum height Ry) of a cell wall is 20-100 micrometers.
[0016]And as for a main crystal of ceramics which constitute a cell wall, it is preferred that it is cordierite. Although it is because heat resistance sufficient as a filter for particle catching, thermal shock resistance, and a mechanical strength are obtained as a main crystal of ceramics which constitute a cell wall is cordierite, This invention is not limited to this and can use materials, such as other heat-resistant ceramics, for example, mullite, alumina, silicon nitride, silicon carbide, nitriding aluminum, lithium aluminium silicate, aluminum titanate, and zirconia.
[0017]
[Embodiment of the Invention]Hereafter, an embodiment of the invention is described in detail.
[0018]The honeycomb filter 10 shown in drawing 1 thru/or drawing 2 was produced as follows. (Adjustment of basic-raw-materials powder) Measure powder, such as kaolin, talc, silica, hydroxylation aluminum, and alumina, and chemical composition with a mass ratio. SiO_2: 47-53%, aluminum$_2O_3$:32-38%, MgO: Ceramics raw material powder was adjusted so that it might become 12 to 16%.
[0019](Plastic matter adjustment for honeycomb structured bodies) As a forming assistant, the quantity of graphite, wheat flour, starch, resin powder, a foaming agent, etc. was changed, and it added as binders, such as methyl cellulose, and lubricant, and an ostomy agent, to ceramics raw material powder, and mixed enough by dry type. Subsequently, the water of the stipulated amount was poured in, still more sufficient mixing was performed, and after shaping mentioned later and calcination, the plastic matter was produced so that the porosity, the average pore size, and surface roughness (maximum height Ry) of the various kinds of a honeycomb structured body might be obtained.
[0020](Extrusion molding) Next, extrusion molding of the plastic matter was carried out using the extrusion-molding public-funds type of a general structure, and the section surrounded with a cell wall produced the Plastic solid which has the honeycomb structure of quadrangular shape.
[0021](Calcination) Calcinate using a batch type firing furnace and, in 150 mm and cell wall thickness, 0.43 mm and the number of cells per 1-cm^2 the Plastic solid which has honeycomb structure by 16 pieces. [the outer diameter of the peripheral wall 11a] [150 mm and length] The honeycomb structure baking body which consists of various kinds of porosity, an average pore size, and nature ceramics of cordierite that have the surface roughness (maximum height Ry) of a cell wall was obtained.
[0022](******) Next, after sticking a masking film on the both-ends side of the baking body which has honeycomb structure with adhesives, it punched so that it might become a checker, and checkered ****** material was introduced into the end, the eye sealed part was formed, and the honeycomb filter 10 was obtained.
[0023](Measurement of porosity, an average pore size, and surface roughness (maximum height Ry)) The sample was started from the obtained honeycomb filter 10, and (%) and the porosity of

a cell wall, an average pore size (micrometer), and surface roughness (maximum height Ry) were measured. The porosity (%) and average pore size (micrometer) of the cell wall were measured with the method of mercury penetration using product [made by Micromeritics] auto pore III9410. Semi- [of the surface roughness (maximum height Ry)] was carried out to B (JIS) 0601-1994, and it was measured several places.

[0024](Measurement of collection efficiency and pressure loss) a honeycomb filter — ten — particle diameter — 0.042 — micrometer — carbon powder — three — g/h — two — an hour — having supplied — the back — (— a —) — collection efficiency — (— % —) — [(input-discharge) — /(input) —] — an inflow — a side — 11 — d — an outflow — a side — 11 — e — differential pressure — having measured . And differential pressure was made into (b) pressure loss (mmAq). From on practical use, that in which (a) collection efficiency is not less than 90%, and (b) pressure loss exceeds [less than 360 mmAq] right (O) and 400mmAq for A (O) and 360 - 400mmAq was set to NG (x), and was evaluated (c). Collection efficiency evaluated less than 90% of thing as NG (x).

[0025]The result of (a) collection efficiency over the porosity, the average pore size, and surface roughness of the honeycomb filter 10, (b) pressure loss, and (c) evaluation is shown in Table 1.

[0026]

[Table 1]

	気孔率 (%)	平均細孔径 (μm)	表面粗さ Ry(μm)	(a)捕集率 (%)	(b)圧力損失 (mmAq)	(c)評価
発明例 1	62.8	14.9	15～30	95	382	○
発明例 2	62.4	14.4	48～68	97	378	○
発明例 3	65.4	14.6	67～89	98	381	○
発明例 4	60.2	16.8	68～76	98	382	○
発明例 5	66.8	19.5	57～74	96	377	○
発明例 6	67.2	21.8	63～79	98	365	○
発明例 7	65.5	30.8	22～44	96	353	◎
発明例 8	68.3	33.7	45～62	98	328	◎
発明例 9	56.8	14.9	47～68	99	396	○
発明例10	70.1	19.7	67～78	96	332	◎
比較例 1	62.4	14.8	3～ 7	87	378	×
比較例 2	45.2	7.7	3～ 7	98	448	×
比較例 3	61.0	9.1	12～14	98	420	×
比較例 4	69.1	48.3	32～55	82	322	×
比較例 5	76.2	30.4	51～70	80	310	×

[0027]As for the examples 1-10 of an invention, Table 1 shows that porosity serves as high the honeycomb filter 10 with little pressure loss in collection efficiency since 55 to 75% and an average pore size are 10-40 micrometers and surface roughness (maximum height Ry) is not less than 10 micrometers.

[0028]On the other hand, since it is outside 55 to 75% of porosity, 10-40 micrometers of average pore sizes, and the range of not less than 10 micrometers of surface roughness (maximum height Ry) any of porosity, an average pore size, and surface roughness (maximum height Ry) they are, as for the comparative examples 1-5, evaluation of collection efficiency and/or pressure loss is low.

[0029]

[Effect of the Invention]In details, above as explanation the honeycomb filter of this invention, Since porosity is carried out, the average pore size is 10-40 micrometers 55 to 75%, a low-pressure power loss is acquired and the surface roughness on the surface of a cell wall is not less than 10 micrometers, it becomes possible to be efficient and to catch the particles in exhaust gas, and extension of catching time is attained.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a perspective view of a honeycomb structured body.
[Drawing 2]It is a cross section of an example of the exhaust gas purifying filter 10 using the honeycomb structured body of drawing 1.
[Description of Notations]
10a: Inflow
10b: Discharge
10: Porosity ceramic honeycomb filter (honeycomb filter)
11: Porosity ceramic honeycomb structured body (honeycomb structured body)
11a: Peripheral wall
11b: Cell wall
11c: Cell
11d: Inflow side
11e: Outflow side
12a, 12b: ****** material

[Translation done.]

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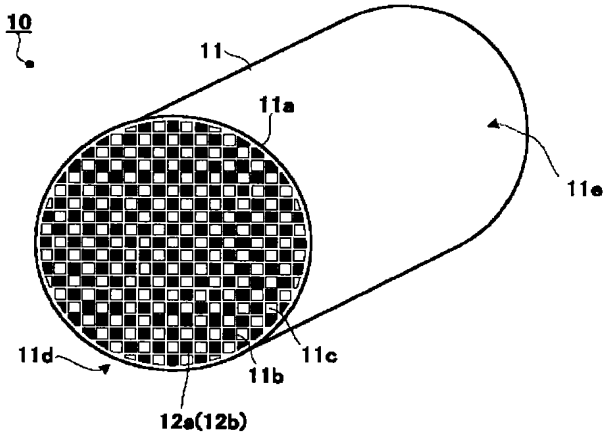
4D019 AA01 BA05 BB06 BD01 CA01
4G019 FA01 FA12 FA13

(54)【発明の名称】　多孔質セラミックハニカムフィルタ

(57)【要約】
【課題】　外周壁と、この外周壁の内周側でセル壁により囲まれた多数のセルを有する多孔質セラミックハニカム構造体のセルの片端面を目封じ材で目封じして、排気ガスを前記セル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子を前記セル壁で捕集するセラミックハニカムフィルタであって、気孔率が５５％以上として触媒を担持しても、排気ガス中の微粒子の捕集効率が高くかつ圧力損失が少ないハニカムフィルタを得る。
【解決手段】　セル壁の気孔率を５５～７５％、平均細孔径を１０～４０μｍ、かつ表面粗さ（最大高さＲｙ）を１０μｍ以上とする。



【特許請求の範囲】
【請求項１】　外周壁と、この外周壁の内周側でセル壁により囲まれた多数のセルを有するハニカム構造体のセルの片端面を目封じ材で目封じして、排気ガスを前記セル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子を前記セル壁で捕集する多孔質セラミックハニカムフィルタであって、前記セル壁の気孔率が５５～７５％、平均細孔径が１０～４０μｍ、表面粗さ（最大高さＲｙ）が１０μｍ以上であることを特徴とする多孔質セラミックハニカムフィルタ。
【請求項２】　前記セル壁の気孔率が６０～７０％であることを特徴とする請求項１記載の多孔質セラミックハニカムフィルタ。
【請求項３】　前記セル壁を構成するセラミックスの主結晶がコージェライトであることを特徴とする請求項１又は請求項２記載の多孔質セラミックハニカムフィルタ。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、ディーゼルエンジンなどの排気ガス中に含まれる微粒子を捕集する多孔質セラミックハニカムフィルタに関する。
【０００２】
【従来技術】地域環境や地球環境の保全面から、自動車などのエンジンから排出される排気ガスに含まれる有害物質の削減が求められている。特にディーゼルエンジンなどの排気ガス中に含まれる微粒子を捕集するため、多孔質セラミックハニカムフィルタ（以下、「多孔質セラミックハニカムフィルタ」を略して「ハニカムフィルタ」という）が注目され、実用されるようになってきた。
【０００３】図１はハニカムフィルタ１０の斜視図であり、図２は、図１のハニカムフィルタ１０の模式断面図である。図１及び図２に示すように、通常、ハニカムフィルタ１０は、略円筒状で、外周壁１１ａと、この外周壁１１ａの内周側でセル壁１１ｂにより囲まれた多数のセル１１ｃを有する多孔質セラミックハニカム構造体（以下、「多孔質セラミックハニカム構造体」を略して「ハニカム構造体」という）１１でのセル１１ｃの流入側１１ｄ、流出側１１ｅの両端面を交互に目封じ材１２ａ、１２ｂで目封じしている。そして、ハニカムフィルタ１０は、金属容器（図示せず）内で圧縮状態として介挿されたセラミック繊維マットなどの把持部材の面圧で金属容器に収納されている。
【０００４】ハニカムフィルタ１０での排気ガス浄化は、以下の通り行われる。図２で、排気ガスは、ハニカムフィルタ１０の流入側１１ｄで開口しているセル１１ｃから流入（１０ａで示す）し、セル壁１１ｂに形成された細孔（図示せず）から隣接セルに流れ、流出側１１ｅから排出（１０ｂで示す）する。そして、排気ガス中に含まれる微粒子などは、セル壁１１ｂ内で連続する細孔から隣接セルに通過する際に沪過され、捕集される。そして、捕集された微粒子が一定量以上になると、電気ヒーターやバーナ等で燃焼除去されハニカムフィルタ１０の再生が行われる。
【０００５】また、ハニカムフィルタ１０のセル壁１１ｂやセル壁１１ｂに形成した細孔(図示せず)に白金属金属触媒などの触媒を担持することにより、微粒子の燃焼温度を下げ、捕集した微粒子を連続的に燃焼させる方法もある。さて、ハニカムフィルタ１０には、微粒子の捕集効率が高いことと、圧力損失が低いことが要求される。微粒子の捕集効率が高く、圧力損失が低ければ、微粒子の蓄積に伴うエンジンへの背圧増加が遅くなって、捕集を継続できる時間が長くなり、再生までのインターバルも長くなる。しかし、一般的に捕集効率と圧力損失は反比例の関係にあり、捕集効率を高くしようとすると圧力損失が増大し、一方、圧力損失を低くしようとすると捕集効率が悪化するようになる。従来、捕集効率と圧力損失が両立できるよう、ハニカムフィルタのセル壁の気孔率や平均細孔径を調整していたが限界があった。特に、担持した触媒で微粒子を連続的に燃焼させる場合、担体として活性アルミナ等の高比表面積材料をセル壁の細孔内部にコーティングする必要があることから、高比表面積材料がセル壁の細孔を閉塞してしまい、コーティングしていないフィルタに比べ圧力損失が高くなって、高捕集効率で低圧力損失のフィルタを得ることは困難であった。
【０００６】上記問題点を解決するため、特開平７－１６３８２３号公報には、セル壁の気孔率を４５％以上６０％以下とすることに加えて、その表面から内部に向かって開口および貫通する全細孔の比表面積Ｍ（m^2／ｇ）と、そのフィルタ表面における表面粗さＮ（μｍ）との関係を１０００Ｍ＋８５Ｎ≧５３０の範囲とすることで、フィルタ面積とフィルタ表面から内部に連鎖して貫通した細孔の数を増加させ、捕集時間が長く、再生回数を少なくできるようにしたハニカムフィルタが開示されている。
【０００７】また、特開平８－９３１号公報には、気孔率を４０％以上５５％以下、平均細孔径を５μｍ以上５０μｍ以下とすることに加えて、Ｖａｌｌｅｙ　Ｌｅｖｅｌなる値を２０％以下とすることで、ハニカムフィルタ表面に捕集された微粒子の剥離性が良くなり、逆洗エアによる再生効率を良くしようとしたハニカムフィルタが開示されている。ここで、Ｖａｌｌｅｙ　Ｌｅｖｅｌとは、触針式表面粗さ計によりフィルタ表面の粗さのデータを３次元解析して、ある面に対してフィルタの凸部の体積と凹部の体積とが等しくなるような面を平均面とし、この平均面でフィルタを切断したと仮定したとき、平均面における細孔面積の和の全表面積に対する比率と定義している。

【０００８】
【発明が解決しようとする課題】しかしながら、前記特開平７－１６３８２３号公報に開示のハニカムフィルタは、表面粗さが、同公報の表２に記載のとおり、実施例で２．３～７．４μｍ、比較例で３．１～７．４μｍ程度であるため、セル壁の捕集面積を大きくする効果は得られず、実質的に微粒子の捕集効率も低いという問題があった。このため、圧力損失が低く、しかも微粒子の捕集効率が高いフィルタを得ることは困難であった。
【０００９】また、前記特開平８－９３１号公報に開示のハニカムフィルタは、気孔率が４０％以上５５％以下であり、圧力損失が増加し易いという問題があった。また、Ｖａｌｌｅｙ　Ｌｅｖｅｌ　なる値を２０％以下とすることで表面に捕集された微粒子の剥離性が良くなるものの、排気ガス中の微粒子をセル壁で捕集する効果が少ないという問題もあった。なお、特開平８－９３１号公報には、表面粗さの値に関して具体的な記載は見当たらない。
【００１０】本発明は、上記課題に鑑みてなされたもので、セル壁の気孔率を大きくして圧力損失を低く抑えると共に、排気ガス中の微粒子の捕集効率が高いハニカムフィルタを得ることにある。
【００１１】
【課題を解決するための手段】本発明者らは、ハニカムフィルタでの気孔率、平均細孔径を特定し、かつセル壁の表面粗さ（最大高さＲｙ）を所定値以上に大きくすることで、上記課題が解決できるとの知見を得、本発明に想到した。
【００１２】即ち、本発明のハニカムフィルタは、外周壁と、この外周壁の内周側でセル壁により囲まれた多数のセルを有するハニカム構造体のセルの片端面を目封じして、排気ガスを前記セル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子を前記セル壁で捕集するハニカムフィルタであって、前記セル壁の気孔率が５５～７５％、平均細孔径が１０～４０μｍ、表面粗さ（最大高さＲｙ）が１０μｍ以上であることを特徴とする。
【００１３】ここで、セル壁の気孔率を５５～７５％としたのは、気孔率が５５％未満であると、圧力損失が大きくなり、気孔率が７５％を超えると、微粒子の捕集効率が低下し、また、強度も低下するため、微粒子捕集用フィルタとしては適さないからである。気孔率のより好ましい範囲は６０～７０％である。
【００１４】また、セル壁の平均細孔径を１０～４０μｍとしたのは、平均細孔径が１０μｍ未満であると、圧力損失が大きくなり、平均細孔径が４０μｍを超えると、微細な微粒子がセル壁を透過して捕集効率が低下し、また強度も低下するため、微粒子捕集用フィルタとしては適さないからである。なお、気孔率及び平均細孔径は、水銀圧入式ポロシメータを用いて測定する。
【００１５】また、セル壁の表面粗さ（最大高さＲｙ）を１０μｍ以上としたのは、気孔率を５５～７５％、平均細孔径を１０～４０μｍと圧力損失が低く抑えられるよう設定しているにもかかわらず、セル壁表面に形成された凸凹部により微粒子を効率よく捕集することが可能となるからである。セル壁の表面粗さ（最大高さＲｙ）が１０μｍ未満では、排気ガス中の微粒子をセル壁で捕集する効果が少なく、微粒子捕集用フィルタとしては適さない。なお、セル壁の表面粗さ（最大高さＲｙ）のより好ましい範囲は、２０～１００μｍである。
【００１６】そして、セル壁を構成するセラミックスの主結晶はコージェライトであることが好ましい。セル壁を構成するセラミックスの主結晶がコージェライトであると、微粒子捕集用フィルタとして十分な耐熱性、耐熱衝撃性、機械的強度が得られるからであるが、本発明はこれに限定されるものではなく、その他の耐熱性セラミックス、例えば、ムライト、アルミナ、窒化珪素、炭化珪素、窒化アルミ、リチウムアルミニウムシリケート、チタン酸アルミニウム、ジルコニア、等の材料を使用することができる。
【００１７】
【発明の実施の形態】以下、発明の実施の形態を詳細に説明する。
【００１８】図１乃至図２に示すハニカムフィルタ１０を以下のようにして作製した。
（基本原料粉末の調整）カオリン、タルク、シリカ、水酸化アルミ、アルミナなどの粉末を計量して、化学組成が質量比で、SiO_2：４７～５３％、Al_2O_3：３２～３８％、ＭｇＯ：１２～１６％となるようにセラミックス原料粉末を調整した。
【００１９】（ハニカム構造体用の坏土調整）セラミックス原料粉末に対し、成形助剤としてメチルセルロース等のバインダ及び潤滑剤、造孔剤として、グラファイト、小麦粉、でん粉、樹脂粉、発泡剤などの量を変えて添加し、乾式で十分混合した。次いで、規定量の水を注入して更に十分な混合を行い、後述する成形及び焼成後、ハニカム構造体の各種の気孔率、平均細孔径及び表面粗さ（最大高さＲｙ）が得られるよう坏土を作製した。
【００２０】（押出成形）次に、坏土を一般的な構造の押出成形用金型を用いて押出成形し、セル壁で囲まれる断面が四角形状のハニカム構造を有する成形体を作製した。
【００２１】（焼成）ハニカム構造を有する成形体を、バッチ式焼成炉を用いて焼成を行い、外周壁１１ａの外径が１５０ｍｍ、長さが１５０ｍｍ、セル壁厚が０．４３ｍｍ、１ｃｍ^2 当たりのセル数が１６個で、各種の気孔率、平均細孔径、セル壁の表面粗さ（最大高さＲｙ）を有するコージェライト質セラミックスからなるハニカム構造焼成体を得た。

【００２２】（目封じ）次に、ハニカム構造を有する焼成体の両端面にマスキングフィルムを接着剤で貼り付けた後、市松模様となるように穿孔し、端部に市松模様の目封じ材を導入し、目封止部を形成し、ハニカムフィルタ１０を得た。

【００２３】（気孔率、平均細孔径、表面粗さ（最大高さＲｙ）の測定）得られたハニカムフィルタ１０から試料を切り出し、セル壁の気孔率（％）、平均細孔径（μｍ）、表面粗さ（最大高さＲｙ）を測定した。なお、セル壁の気孔率（％）及び平均細孔径（μｍ）は、Ｍｉｃｒｏｍｅｒｉｔｉｃｓ社製オートポアIII９４１０を用い水銀圧入法で測定した。また、表面粗さ（最大高さＲｙ）は、（ＪＩＳ）Ｂ　０６０１－１９９４に準して数箇所測定した。

【００２４】（捕集率及び圧力損失の測定）ハニカムフィルタ１０に粒径０．０４２μｍのカーボン粉を３ｇ／ｈで２時間投入した後の（ａ）捕集率（％）［（投入量－排出量）／（投入量）］と、流入側１１ｄと流出側１１ｅの差圧を測定した。そして差圧を（ｂ）圧力損失（ｍｍＡｑ）とした。また実用上から、（ａ）捕集率が９０％以上で、かつ（ｂ）圧力損失が、３６０ｍｍＡｑ未満を優（◎）、３６０～４００ｍｍＡｑを良（○）、４００ｍｍＡｑを超えるものをＮＧ（×）として評価（ｃ）した。また、捕集率が９０％未満のものはＮＧ（×）として評価した。

【００２５】表１に、ハニカムフィルタ１０の気孔率、平均細孔径及び表面粗さに対する、（ａ）捕集率、（ｂ）圧力損失、（ｃ）評価の結果を示す。

【００２６】

【表１】

	気孔率(%)	平均細孔径(μm)	表面粗さRy(μm)	(a)捕集率(%)	(b)圧力損失(mmAq)	(c)評価
発明例１	62.8	14.9	15～30	95	382	○
発明例２	62.4	14.4	48～68	97	378	○
発明例３	65.4	14.6	67～89	98	381	○
発明例４	60.2	16.8	68～76	98	382	○
発明例５	66.8	19.5	57～74	96	377	○
発明例６	67.2	21.8	63～79	98	365	○
発明例７	65.5	30.8	22～44	96	353	◎
発明例８	68.3	33.7	45～62	98	328	◎
発明例９	56.8	14.9	47～68	99	396	○
発明例10	70.1	19.7	67～78	96	332	◎
比較例１	62.4	14.8	3～７	87	378	×
比較例２	45.2	7.7	3～７	98	448	×
比較例３	61.0	9.1	12～14	98	420	×
比較例４	69.1	48.3	32～55	82	322	×
比較例５	76.2	30.4	51～70	80	310	×

【００２７】表１から、発明例１～１０は、気孔率が５５～７５％、平均細孔径が１０～４０μｍ、表面粗さ（最大高さＲｙ）が１０μｍ以上であるので、捕集率が高く、かつ圧力損失の少ないハニカムフィルタ１０となっていることがわかる。

【００２８】一方、比較例１～５は、気孔率、平均細孔径、表面粗さ（最大高さＲｙ）の何れかが、気孔率５５～７５％、平均細孔径１０～４０μｍ、表面粗さ（最大高さＲｙ）１０μｍ以上の範囲外であるので、捕集率及び／又は圧力損失の評価が低くなっている。

【００２９】

【発明の効果】以上詳細に説明のとおり、本発明のハニカムフィルタは、気孔率を５５～７５％、平均細孔径を１０～４０μｍとしていることから、低圧力損失が得られ、セル壁表面の表面粗さを１０μｍ以上としているため、排気ガス中の微粒子を高効率で捕集することが可能となり、捕集時間の延長が可能となる。

【図面の簡単な説明】

【図１】ハニカム構造体の斜視図である。

【図２】図１のハニカム構造体を用いた排気ガス浄化フィルタ１０の一例の断面模式図である。

【符号の説明】

１０ａ：流入

１０ｂ：排出

１０：多孔質セラミックハニカムフィルタ（ハニカムフィルタ）

１１：多孔質セラミックハニカム構造体（ハニカム構造体）

１１ａ：外周壁

１１ｂ：セル壁

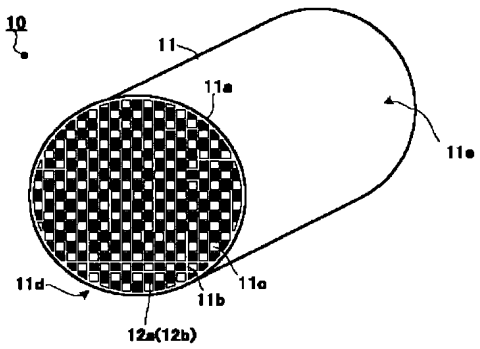
１１ｃ：セル

１１ｄ：流入側

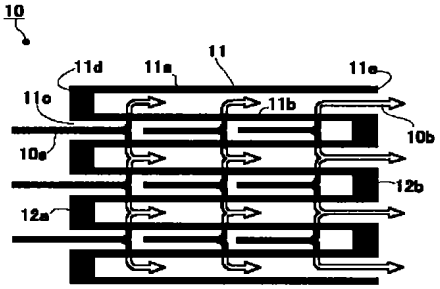
１１ｅ：流出側

１２ａ，１２ｂ：目封じ材

【図１】


10
11
11a
11e
11d
11b
11c
12a(12b)

【図２】


10
11d
11a
11
11e
11c
11b
10b
10a
12b
12a